

REMARKS

Applicant respectfully requests consideration of this application.

Office Action Objections and Rejections Summary

The drawings have been objected to under 37 C.F.R. 1.83(a). In particular, the Office Action states that the features of claims 42, 43, 45, and 46 are not shown in the drawings. Claims 29 and 35 have been objected to because of informalities. Claims 42 – 43 and 45 – 46 have been rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. Claims 1 – 3, 7, 10 – 11, 16, 18 – 19, 21 – 23, 29, 31, 42, and 45 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Yamamoto et al., U.S. Patent No. 4,729,060 (hereinafter “Yamamoto”). Claims 1 and 32 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Novotny, U.S. Patent No. 5,206,791 (hereinafter “Novotny”).

Claims 4, 9, 17, 27 – 28, and 43 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto. Claims 5, 11 – 13, 15, 20, 25 – 26, and 45 – 46 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto as applied to claims 1 and 42, and further in view of Grunfeld, U.S. Patent No. 5,847,366 (hereinafter “Grunfeld”). Claims 32 – 35 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Novotny as applied to claims 1 and 32, and further in view of Hisano et al., U.S. Patent No. 5,198,889 (hereinafter “Hisano”).

Status of Claims

Claims 1 – 5, 7, 9 – 13, 15 – 23, 25 – 29, 31 – 35, 42 – 46 remain pending in this application. Claims 1, 29, 35, and 42 have been amended. The amendments are supported by the specification and no new matter has been added. No new claims have been canceled. No new claims have been added.

Objections to the Drawings

The drawings have been objected to under 37 C.F.R. 1.83(a). In particular, the Office Action states that the feature, “the means for positioning said electronic or electrical device proximate a conduit having a flexible channel attached thereto” of claims 42, 43, 45, and 46 are not shown in the drawings. Applicant respectfully submits that this feature is illustrated in at least Figures 8A – 8B, which include conduit 301 with flexible channels 803A and 803B attached. Integrated circuits 810, 811 (i.e., electronic or electrical device) are positioned on a surface of PCB 820 and facing the flexible channels 803A and 803B. Figure 8A illustrates the flexible channels separated from the ICs and Figure 8B illustrates the flexible channels and conduit proximate the ICs. As such, applicant respectfully submits that the features of 42, 43, 45, and 46 are shown in the drawings as originally filed and request removal of the objection.

Objections to Claims

Claims 29 and 35 have been objected to because of informalities. Appropriate corrections to claims have been made to claims 29 and 35 with amendments. The amendments are supported by the specification and no new matter has been added.

Rejections Under 35 U.S.C. 112

Claims 42 – 43 and 45 – 46 have been rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. In particular, the Office Action states that the specification or drawings do not provide support for the structural limitation, “the means for positioning said electronic or electrical device proximate a conduit having a flexible channel attached thereto.” Applicant respectfully submits that this structural limitation is supported in the specification and drawings as originally filed in at least paragraphs [0050] – [0055] and Figures 8A – 8B. Figures 8A – 8B illustrate conduit

301 with flexible channels 803A and 803B attached. Integrated circuits 810, 811 (i.e., electronic or electrical device) are positioned on a surface of PCB 820 and facing the flexible channels 803A and 803B. Figure 8A illustrates the flexible channels separated from the ICs and Figure 8B illustrates the flexible channels and conduit proximate the ICs. As such, applicant respectfully submits that support for claims 42, 43, 45, and 46 are provided in the specification and drawings as originally filed and request removal of the rejection.

Rejections Under 35 U.S.C. 102(b)

Claims 1 – 3, 7, 10 – 11, 16, 18 – 19, 21 – 23, 29, 31, 42, and 45 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Yamamoto. Applicant respectfully submits that claims 1 – 3, 7, 10 – 11, 16, 18 – 19, 21 – 23, 29, 31, 42, and 45 are patentable over Yamamoto.

Amended independent claim 1 provides:

A cooling device for removing heat from an integrated circuit, said cooling device comprising:

a conduit;

a flexible channel to alternate between a compressed position and an extended position and having a first open end and a second closed end, said first open end coupled with said conduit, said open end having an internal width, said flexible channel comprised of a resilient material having spring-like characteristics, said material to provide a spring-like restoring force when compressed, the second closed end comprising a thermally conductive material attached to said flexible channel, ***said thermally conductive material having a substantially planar surface to interface directly with said integrated circuit when said flexible channel is extended and to detach from said integrated circuit in said compressed position;***

an interconnect mechanism between said conduit and said flexible channel to allow a fluid introduced within said conduit to move between said conduit and said flexible channel; and

a heat sink attached to an interior surface of said closed end to cause heat absorbed by said closed end to be conducted through said conduit and said flexible channel. (emphasis added)

Amended independent claim 42 provides:

A cooling device for removing heat from an electronic or electrical device, said cooling device comprising:

means for positioning said electronic or electrical device proximate a conduit having a flexible channel attached thereto, said flexible channel to alternate between a compressed position and an extended position;

means for extending said flexible channel until a closed end of said flexible channel contacts said electronic or electrical device, said closed end comprising a thermally conductive material having a substantially planar surface to **interface directly with said electronic or electrical device when said flexible channel is in said extended position and to detach from said electronic or electrical device in said compressed position**, and a heat sink attached to an interior surface of said closed end to cause heat absorbed by said closed end to be conducted through said conduit and said flexible channel; and

means for contracting said flexible channel to remove said closed end from said electronic or electrical device. (emphasis added)

Yamamoto discloses a cooling system including a cooling module with a heat transfer plate. In particular, Yamamoto includes the following disclosure.

A first heat transfer plate 3 which is made of, for example, a heat conductive material, such as copper or brass, is connected to conduit 1 by means of a bellows 5 attached to conduit 1. The bellows 5 is usually made of a thin sheet of copper or stainless steel. Conduit 1 has therein, preferably, a deflector 21 extending toward the first heat transfer plate 3. A coolant recirculation zone 32 is defined in the bellows 5, in which zone 32 the first heat transfer plate 3 is exposed to the coolant at one side face of the plate 3. The direction of the coolant flow in conduit 1 is changed by the deflector 21, which can be dispensed with, and thus the heat is removed from the first heat transfer plate 3 in the circulation zone 32. **The plate 3 is pressed against an electronic circuit component 7, such as an IC, LSI, or semiconductor provided on a printed circuit board 9, by means of the bellows 5 and the hydraulic pressure of the coolant.** The component 7 is bonded to the printed circuit board 9 by, for example, solder 11. The component 7 illustrated in FIG. 1 has a tip 6 and a package 8. In the illustrated embodiment of FIG. 1, a second heat transfer plate 10 is adhered to and on the component 7 by, for example, soldering or die bonding. The first heat transfer plate 3 forms a heat sink head. (emphasis added)

(Yamamoto, col. 4, lines 45 – 68, and Figure 1).

It appears that the heat transfer plate, and in turn the bellows, are in constant contact with the electronic circuit component. Nothing in Yamamoto discloses that the bellows can detach from the circuit component in a compressed position and attach to the circuit

component in an expanded position. In fact, there is no figure in Yamamoto that illustrates the bellows detached from the electronic circuit component.

In contrast, independent claim 1 includes the limitation of, "said thermally conductive material having a substantially planar surface to interface directly with said integrated circuit when said flexible channel is extended and to detach from said integrated circuit in said compressed position," and independent claim 42 includes the limitation of, "interface directly with said electronic or electrical device when said flexible channel is in said extended position and to detach from said electronic or electrical device in said compressed position." As such, applicant respectfully submits that claims 1 and 42 are patentable over Yamamoto under 35 U.S.C. § 102(b) and request removal of the rejection.

Claims 2, 3, 7, 10, 11, 16, 18, 19, 21 – 23, 29 and 31 each depend either directly or indirectly from independent claim 1, and thus include the limitation of, "said thermally conductive material having a substantially planar surface to interface directly with said integrated circuit when said flexible channel is extended and to detach from said integrated circuit in said compressed position." Claim 45 depends directly from independent claim 42 and thus includes the limitation of, "interface directly with said electronic or electrical device when said flexible channel is in said extended position and to detach from said electronic or electrical device in said compressed position." Accordingly, applicant respectfully submits that claims 2, 3, 7, 10, 11, 16, 18, 19, 21 – 23, 29, 31, and 45 are also patentable over Yamamoto under 35 U.S.C. § 102(b) and request removal of the rejection.

Claims 1 and 32 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Novotny. Applicant respectfully submits that claims 1 and 32 are patentable over Novotny. Novotny discloses a cooling system. In particular, Novotny includes the following disclosure:

The resilient bellows pipe element 10 is expandable in all three axial dimensions. ***The spring constant of the resilient bellows pipe element 10 provides the mechanical load for maintaining constant contact between the conductive heat sink member 11 and the integrated circuit or integrated circuit package 12.*** Maintaining the correct mechanical load reduces the thermal contact resistance between the conductive heat sink member 11 and the integrated circuit device 12. The mechanical load is typically calculated based on the pressure that is optimal for lowest contact resistance. The minimum pressure required for lowest contact resistance is a function of the characteristics of the surface finish of the integrated circuit device 12, the bellows material which contacts the integrated circuit (the bellows sink material), and the thermally conductive filling material 13. For example, the calculations for the preferred embodiment could be derived utilizing an integrated circuit with a smooth surface finish, a bellows sink material made of polished copper and filling material comprised of indium. A bellows device providing approximately 50 pounds per square inch of mechanical load on the integrated circuit device could satisfy the minimum pressure requirement and accordingly optimum thermal transfer between the integrated circuit 12 and the liquid 16. (emphasis added)

(Novotny, col. 5, lines 10 – 35 and Figure 1)

It appears that the bellows of Novotny are in constant contact with the integrated circuit. Nothing in Novotny discloses that the bellows can detach from the integrated circuit in any position. Moreover, there is no figure in Novotny that illustrates the bellows detached from the electronic circuit component.

In contrast, independent claim 1 includes the limitation of, “said thermally conductive material having a substantially planar surface to interface directly with said integrated circuit when said flexible channel is extended and to detach from said integrated circuit in said compressed position.” As such, applicant respectfully submits that claim 1 is patentable over Novotny under 35 U.S.C. § 102(b) and request removal of the rejection.

Claim 32 depends from independent claim 1, and thus includes the limitation of, “said thermally conductive material having a substantially planar surface to interface directly with said integrated circuit when said flexible channel is extended and to detach from said integrated circuit in said compressed position.” Accordingly, applicant respectfully submits

that claim 32 is also patentable over Novotny under 35 U.S.C. § 102(b) and request removal of the rejection.

Rejections Under 35 U.S.C. §103(a)

Claims 4, 9, 17, 27 – 28, and 43 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Yamamoto. Applicant respectfully submits that claims 4, 9, 17, 27 – 28, and 43 are patentable over Yamamoto. Claims 4, 9, 17, and 27 – 28 depend either directly or indirectly from independent claim 1 and thus include the limitation of “said thermally conductive material having a substantially planar surface to interface directly with said integrated circuit when said flexible channel is extended and to detach from said integrated circuit in said compressed position.” Claim 43 depends from independent claim 42 and thus includes the limitation of, “interface directly with said electronic or electrical device when said flexible channel is in said extended position and to detach from said electronic or electrical device in said compressed position.” As discussed above, nothing in Yamamoto discloses this limitation. Accordingly, applicant respectfully submits that claims 4, 9, 17, 27 – 28, and 43 are patentable over Yamamoto under 35 U.S.C. §103(a) and request removal of the rejection.

Claims 5, 11 – 13, 15, 20, 25 – 26, and 45 – 46 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Yamamoto as applied to claims 1 and 42, and further in view of Grunfeld. Applicant respectfully submits that claims 5, 11 – 13, 15, 20, 25 – 26, and 45 – 46 are patentable over Yamamoto and Grunfeld. Claims 5, 11 – 13, 15, 20, and 25 – 26 each depend either directly or indirectly from claim 1 and thus include the limitation of, “said thermally conductive material having a substantially planar surface to interface directly with said integrated circuit when said flexible channel is extended and to detach from said

integrated circuit in said compressed position.” Claims 45 – 46 each depend either directly for indirectly from independent claim 42 and thus include the limitation of, “interface directly with said electronic or electrical device when said flexible channel is in said extended position and to detach from said electronic or electrical device in said compressed position.” As discussed above, nothing in Yamamoto discloses or suggests this limitation.

Grunfeld discloses an apparatus for controlling the temperature of an integrated circuit under test. In particular, Grunfeld includes the following disclosure:

In one embodiment of the present invention (See FIG. 1), a cooling apparatus 10 comprising a bellows 12, heat slug 14, and reservoir 16 is provided. Supply and return lines 20 and 22 containing check valves 24 and 26, respectively, are provided to facilitate the transfer of a heat transfer medium (fluid) 28 between bellows 12 and reservoir 16. Bellows 12 includes a plurality of fins 15 that extend along at least a portion of the bellow's length. In FIG. 1, cooling apparatus 10 is shown contacting the backside of an integrated circuit (die) 40 that is housed within a LGA package 42. Testing of the integrated circuit 40 is achieved by placing the LGA contact lands 44 in electrical contact with a corresponding array of pogo pins or contacts 52 formed along the surface of a load board or contactor 50 of a testing apparatus. Once electrical contact with contactor 50 and LGA 42 is achieved, integrated circuit 40 may be tested in accordance with any of a number of testing methods and sequences. In any event, testing typically involves the coupling of circuit 40 to a voltage source and some mode of circuit operation. This, in turn, results in the generation of heat which must be dissipated from the integrated circuit device in order to conform to applicable test requirements and/or to maintain the temperature of the device within safe operating limits. With continuing reference to FIG. 1, ***heat is transferred from device 40 by engaging the flat surface of heat slug 14 with the backside of device 40 and applying a force, F.sub.1, to bellows 12.***

(emphasis added) (Grunfeld, col. 3, lines 15 – 43, and Figure 1)

It appears that the bellows of Grunfeld does not separate from the integrated circuit housed within the package, either directly or indirectly. In fact, there is no disclosure of suggestion in Grunfeld of such as separation. As such, Grunfeld fails to cure the deficiency of Yamamoto. Accordingly, applicant respectfully submits that dependent claims 5, 11 – 13, 15, 20, 25 – 26, and 45 – 46 are patentable over Yamamoto in view of Grunfeld under 35

U.S.C. §103(a) and request removal of the rejection.

Claims 32 – 35 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Novotny as applied to claims 1 and 32, and further in view of Hisano. Applicant respectfully submits that claims 32 – 35 are patentable over Novotny and Hisano. Claims 32 – 35 each depend either directly or indirectly from independent claim 1, and thus includes the limitation of, “said thermally conductive material having a substantially planar surface to interface directly with said integrated circuit when said flexible channel is extended and to detach from said integrated circuit in said compressed position.” As discussed above, nothing in Novotny discloses or suggests this limitation.

Hisano discloses a cooling apparatus which includes a cooling stud that is thermally jointed to a heat generating member. In particular, Hisano includes the following disclosure:

A bellows part 81a with elastic characteristics is formed on the semiconductor chip 1 side of the cap 81, and a flexible sheet 82 with good heat conductivity is thermally connected between the bottom of the bellows part 81a and the semiconductor chip 1. In addition, a plurality of pipe sections 81b are provided. A fin 83 is mounted on each pipe section 81b integrally formed on the upper part of the cap 81. In the embodiment with this configuration, ***the pressure exerted on the semiconductor chips 1 can be applied uniformly by adjusting the bellows section 81a of the cap 81 so that the semiconductor chips 1 maintain good, intimate contact with the bottom surface of the bellows section 81a of the cap 81, thus lowering the thermal resistance.***

(emphasis added) (Hisano, col. 18, lines 12 – 19, and Figure 29)

It appears that the bellows of Hisano does not separate from the semiconductor chip, either directly or indirectly. In fact, there is no disclosure of suggestion in Hisano of such as separation. As such, Hisano fails to cure the deficiency of Novotny. Accordingly, applicant respectfully submits that dependent claims 32 – 35 are patentable over Novotny in view of Hisano under 35 U.S.C. §103(a) and request removal of the rejection.

If the allowance of these claims could be facilitated by a telephone conference, the

Examiner is invited to contact Suk Lee at (408) 720-8300. If there are any additional charges, please charge our Deposit Account No. 02-2666.

Respectfully submitted,

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